

Advanced Flow Analysis Tools for Transient Solid Rocket Motor Simulations, Phase I

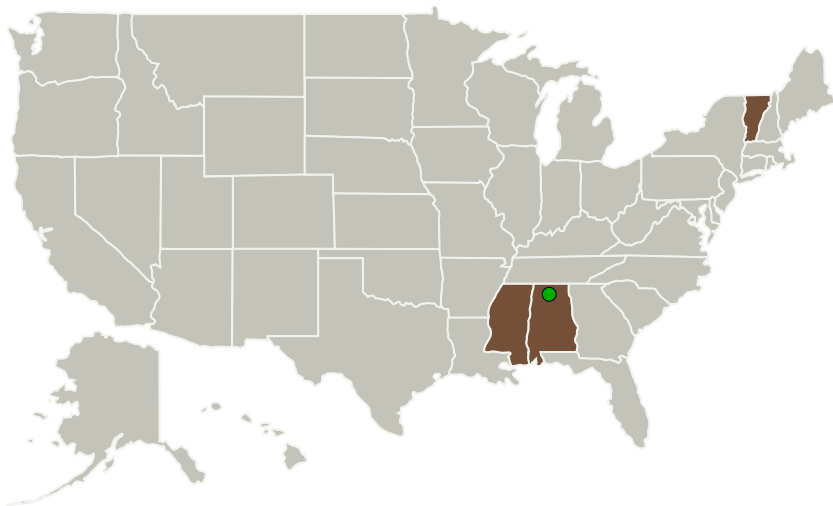
Completed Technology Project (2011 - 2012)



Project Introduction

The challenges of designing, developing, and fielding man-rated propulsion systems continue to increase as NASA's mission moves forward with evolving solid propulsion requirements. Recent developments in simulating solid rocket motor environments include Lagrangian particle tracking, particle combustion models, dynamic particle drag and breakup models, and two phase impingement phenomena. These advances are demonstrating success in numerically simulating solid motor environments, but evolutionary innovations leading to more realistic simulations are required. In particular, transient ignition phenomena, such as grain surface heating, initiation of surface reactions, and transition to steady burning, have not yet been addressed. Consideration of these transient flow aspects is extremely important for analyzing ignition delay, pressure buildup, nonuniform grain recession, and overall combustion behavior. Our research will combine existing two phase flow tools for solid motors with a grain heating and ignition model to produce software tools for simulating transient ignition phenomena and the subsequent flow development. These products will ultimately provide NASA with the important capability to simultaneously analyze solid propellant ignition and combustion, heat transfer, and grain burnback within a unified framework. We will demonstrate feasibility using a two phase solid propellant ignition model for a simple grain shape in the TRL range of 3-4.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Tetra Research Corporation	Lead Organization	Industry Women-Owned Small Business (WOSB)	Princeton, Illinois
● Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Mississippi
Vermont	

Project Transitions

**February 2011:** Project Start**February 2012:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/140248>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Tetra Research Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Robert R Chamberlain

Co-Investigator:

Rex Chamberlain

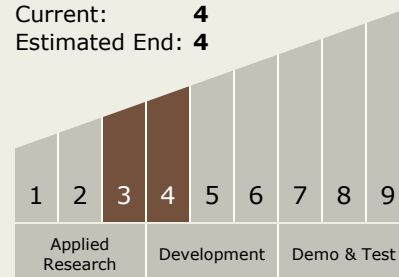
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Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX01 Propulsion Systems
 - └ TX01.1 Chemical Space Propulsion
 - └ TX01.1.4 Solids

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System